

# Use of Magnesium Hydroxide for Reduction of SO<sub>3</sub> Emissions from Coal-Fired Power Plants

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## Summary

Combustion of high-sulfur coal combined with selective catalytic reduction (SCR) produces a high concentration of sulfur trioxide (SO<sub>3</sub>) in flue gas. When wet FGD is also in use, the resulting high SO<sub>3</sub> concentration at the stack exit greatly increases plume visibility. Reduction of SO<sub>3</sub> concentration to less than 5 ppmv at the stack exit is necessary to eliminate visibility due to SO<sub>3</sub>. As a result, many existing coal-fired generating units equipped with both wet FGD and SCR are seeking retrofit of systems to remove SO<sub>3</sub>. Injection of magnesium hydroxide into flue gas is a low-capital cost retrofit technology for this purpose. Moreover, power stations with wet FGD using magnesium-enhanced lime (MEL, Thiosorbic<sup>®</sup>) produce magnesium hydroxide as a low-cost byproduct, and this byproduct is suitable for injection to capture SO<sub>3</sub>.

Results of pilot plant testing demonstrate that byproduct magnesium hydroxide injection into flue gas ahead of an air preheater efficiently captures SO<sub>3</sub>. The testing also demonstrates beneficial effects of byproduct magnesium hydroxide injection on air preheater operation. The 1.6 MW pilot was originally designed and installed under a DOE-NETL project, and Carmeuse is privately funding additional testing. The pilot plant includes a Ljungstrom<sup>®</sup> air preheater which takes flue gas from the economizer exit of a high-sulfur bituminous coal-fired boiler. To simulate flue gas from generating units burning high-sulfur coal and equipped with SCR, SO<sub>3</sub> is added to the flue gas to increase SO<sub>3</sub> concentration to about 50 ppmv. Byproduct magnesium hydroxide slurry is atomized and injected into flue gas immediately ahead of the air preheater. To demonstrate that magnesium hydroxide injection can protect the air preheater from deposits due to acid condensation, the air preheater flue gas exit temperature was reduced to 220°F for 32 days, and the flue gas side pressure loss was monitored.

Results demonstrate SO<sub>3</sub> reduction from 50 ppmv to 10 ppmv or less at the air preheater flue gas entrance at injection rates of 3-4.5 moles of Mg(OH)<sub>2</sub> per mole of SO<sub>3</sub> in flue gas prior to injection. Reduction to 10 ppmv SO<sub>3</sub> at this location is expected to yield less than 5 ppmv at a power plant stack due to additional incidental SO<sub>3</sub> capture across the air preheater, particulate collector, and FGD scrubber.

The results appear to demonstrate that SO<sub>3</sub> reduction protects the air preheater from deposits due to acid condensation. With byproduct magnesium hydroxide injection and with the air preheater flue gas exit temperature reduced to 220°F, no increase in gas pressure loss was observed after 32 days of operation. Additional testing is underway to confirm this finding. Operation at this low exit temperature demonstrates potential for an increase in generating efficiency and corresponding reduction in CO<sub>2</sub> emissions.